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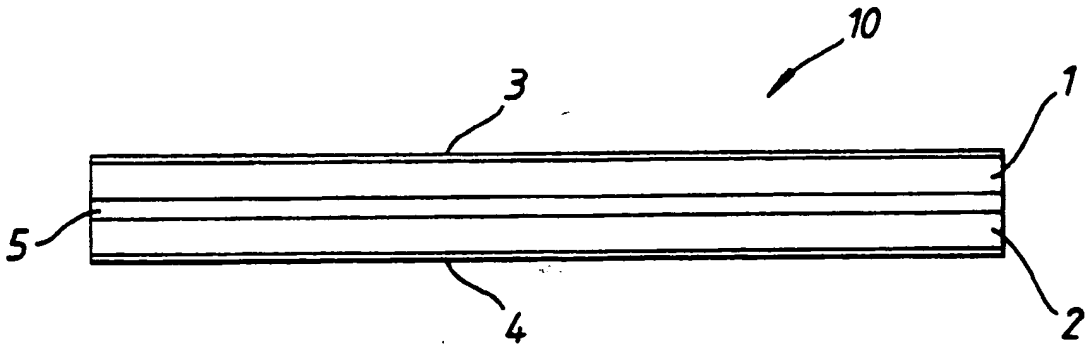
(54) Glass laminates.

(57) A fire-resistant glass laminate (10) is described, comprising an organic polymeric interlayer (5) sandwiched between opposed panes of glass (1,2). An infra-red reflecting doped tin oxide coating (3 or 4) on an exposed glass face of the laminate (10) increases the integrity failure time of the laminate (10). The laminate (10) may be used, for instance, as a fire-resistant safety glazing in an internal door or partition.



EP 0 389 291 A1

GLASS LAMINATES

The invention relates to glass laminates and their use as barriers to fire.

Glass laminates incorporating an intumescent inorganic interlayer sandwiched between opposed glass panes are known, for example PYROSTOP glass (PYROSTOP is a trade mark of Flachglas AG) available from Pilkington Glass Limited in UK and from Flachglas AG in the Federal Republic of Germany. On exposing such glass to fire, the interlayer intumesces providing a thermally insulating layer which protects the pane of glass remote from the fire so that the structural integrity of the unit is maintained sufficiently to prevent the spread of flame. The thermally insulating layer also reduces the transmission of thermal radiation through the laminate reducing the risk of combustion caused by overheating of materials, especially textile materials, on the side of the laminate remote from the fire. It has been proposed in UK patent 1 518 958 to employ, in such a laminate, at least one ply which bears at least one infra-red reflecting coating isolated from the intumescent interlayer. The coating may be a thin metal coating (for example of aluminium, silver, copper or gold) or a metal oxide coating, for example, a tin oxide coating doped with chlorine, fluorine, arsenic or antimony. The coating is used primarily to screen the intumescent material from solar infra-red radiation which is believed to cause degradation of the intumescent interlayer. However, it is said that, if the coating is between the intumescent interlayer and the fire, then the intumescent material will take longer to heat to a given temperature and will thus provide a more effective thermal barrier. Unfortunately, while glass laminates of this type have a high fire resistance, they are very expensive to produce.

It has also been proposed, in European patent specification EP 0 276 634A1, to improve the fire resistance of safety glass laminated incorporating a polymeric organic interlayer between two panes of glass by incorporating a reinforcing wire mesh in the interlayer. However, any improvement resulting from incorporation of the wire mesh is limited, and there remains a need to improve the fire resistance of laminated safety glass incorporating polymeric organic interlayers.

It has now been found that the fire resistance of laminated glass panels comprising an organic polymeric interlayer sandwiched between opposed panes of glass may be substantially improved by providing an infra-red reflecting doped tin oxide coating on an exposed face of the laminate facing the fire.

According to the present invention, there is provided a fire-resistant glass laminate comprising an organic polymeric interlayer sandwiched between opposed panes of glass in which an exposed glass face of the laminate bears an infra-red reflecting doped tin oxide coating.

Surprisingly, even better results may be achieved if an infra-red reflecting doped tin oxide coating is also provided on the exposed face of the laminate remote from the fire.

According to a preferred aspect of the invention, the opposite exposed faces of the laminate each bears an infra-red reflecting doped tin oxide coating.

It might have been expected that the use of the infra-red reflecting coating on the face of the laminate remote from the fire would lead to more rapid heating of the interlayer, and therefore be avoided, especially when using an organic interlayer liable to burn. However, we have found that this effect is usually small and less important than the advantage gained from reduced transmission of heat, with consequent risk of combustion, to the space on the side of the laminate remote from the fire.

The coating used in the laminates of the invention, being a tin oxide coating, has a high level of durability which makes it suitable for use on exposed surfaces. It preferably has a thickness in the range 100 nm to 1200 nm and, if thinner than 800 nm, is preferably used in conjunction with a colour-suppressing underlayer, for example, as described in UK patent specification GB 2 031 756B.

The fire-resistant glass laminate may be a laminated safety glass. The organic polymeric interlayer will usually be an elastomeric interlayer. An organic polymeric interlayer may be, for example, silicone, polyvinylbutyral or an interlayer, such as a polymethacrylate or other polyacrylate, produced by polymerisation of a liquid resin in situ between two panes of glass (a "cast-in-place interlayer). If desired, the interlayer may incorporate fire retardant additives, and/or a reinforcing wire mesh as described in European patent specification EP 0 276 634A1.

Although the exposed glass face or faces of the laminate may be coated after production of the laminate, it is generally most convenient to produce the laminate (in known manner) using coated glass.

The invention is illustrated but not limited by the following description with reference to the drawing which shows a side elevation of a laminated safety glass (10) in accordance with the invention. In the laminate (10) shown in the drawings, the outer panes (1 and 2) are panes of flat glass, for example float glass, each with a fluorine-doped tin oxide coating (3, 4) on its exposed surface. The panes are united by an interlayer (5)

between them.

A laminate (10), as shown in the drawings, was constructed with the panes (1, 2) of 4 mm clear float glass, each 858 mm x 858 mm and bearing a coating (3, 4) comprising a fluorine doped tin oxide layer about 300 nm thick over a colour suppressing underlayer as described in UK patent 2 031 756B. The panes were laminated together with a cast-in-place interlayer (5) of polymethyl methacrylate 1.8 mm thick, polymerised from a methyl methacrylate resin commercially available as Naftolan 5696 ("Naftolan" is a trade mark) from Chemetall of Frankfurt, West Germany. The glass was not edgeworked.

The laminate was glazed into a timber frame which was fixed into a steel frame, and the steel frame placed in an indicative fire test rig in accordance with BS 476 Part 22, and exposed to the heating cycle set out in said Part of the Standard.

The laminate withstood the test for $11\frac{1}{2}$ minutes, after which flaming occurred along one vertical edge of the outer (remote from the fire) pane. This time of $11\frac{1}{2}$ minutes is the integrity failure time according to the above BS 476 Part 22. After 15 minutes the inner pane fell inwards and, after $15\frac{1}{2}$ minutes, the outer pane collapsed.

Tests on two substantially identical constructions resulted in integrity failures (according to BS 476 Part 22) after 22 and 12 minutes respectively. In a comparative test on a similar laminate, without the coatings, the laminate had collapsed completely after 8 minutes.

The tests show that use of the doped infra-red tin oxide coating result in a significant extension in the period for which the laminate resists the fire, as well as reducing the transmission of heat to the space on the side of the laminate remote from the fire.

Further tests on a substantially identical construction, using equivalent glass panes 450 mm x 860 mm with a silicone interlayer, resulted in integrity failures at 26 minutes without the coatings and 32 minutes with the coatings according to the present invention. Thus the use of doped tin oxide coatings on the exposed faces of a fire-resistant laminate enables the important commercial advance of a fire-resistant glass laminate passing the 30 minute fire test.

Claims

1. A fire resistant glass laminate (10) comprising an organic polymeric interlayer (5) sandwiched between opposed panes of glass (1, 2) characterised in that an exposed glass face of the laminate (10) bears an infra-red reflecting doped tin oxide coating (3 or 4).

2. A fire-resistant glass laminate (10) according to claim 1 characterised in that the opposite exposed faces of the laminate (10) each bears an infra-red reflecting doped tin oxide coating (3, 4).

3. A fire-resistant glass laminate (10) according to claim 1 or claim 2 characterised in that the or each infra-red reflecting doped tin oxide coating (3, 4) is a fluorine doped tin oxide coating.

4. A fire-resistant glass laminate (10) according to any one of the preceding claims characterised in that the or each infra-red reflecting doped tin oxide coating (3,4) has a thickness in the range 100 nm to 1200 nm.

5. A fire-resistant glass laminate (10) according to any one of the preceding claims characterised in that the glass laminate is a laminated safety glass.

6. A fire-resistant glass laminate (10) according to any one of the preceding claims characterised in that the interlayer (5) is a polyvinylbutyral interlayer.

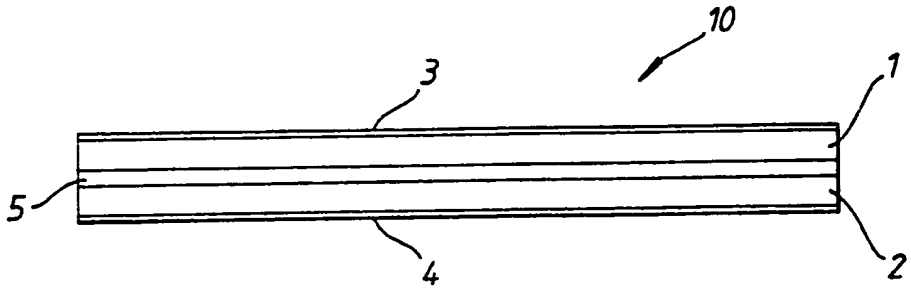
7. A fire-resistant glass laminate (10) according to any one of claims 1 to 5 characterised in that the interlayer (5) is a polyacrylate interlayer.

8. A fire-resistant glass laminate (10) according to any one of claims 1 to 5 characterised in that the interlayer (5) is a silicone interlayer.

9. A fire-resistant glass laminate (10) according to any one of claims 1 to 5 characterised in that the interlayer (5) is produced by polymerisation of a liquid in situ between the two panes of glass (1, 2).

10. A fire-resistant glass laminate (10) according to any of the preceding claims characterised in that the interlayer (5) contains a fire-resistant additive.

11. Use of a laminate (10) according to any of the preceding claims as a fire-resistant safety glazing in an internal door or partition.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EUROPEAN SEARCH REPORT

Application number

EP 90303115.1

DOCUMENTS CONSIDERED TO BE RELEVANT

Category	Citation of document with indication, where appropriate, of relevant passages	Relevant to claim	CLASSIFICATION OF THE APPLICATION (Int Cl.5)
D,X	GB - A - 1 518 958 (BFG) * Fig. 4; page 3, lines 11-14,35-42; page 2, lines 119-130; page 5, lines 112-116 *	1,3-6, 8,10	B 32 B 17/06 B 32 B 17/10 C 03 C 27/12 C 03 C 17/23 E 06 B 5/16
A	--	2,9,11	
A	GB - A - 1 451 933 (GLAVERBEL) * Page 1, lines 79-91; page 3, lines 22-34 *	1,6,9	
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	EP - A1 - 0 215 976 (SEKISUI) * Column 1, lines 1-8; column 4, lines 47-54; column 5, lines 46-52 *	1,6,7	
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A	EP - A1 - 0 207 181 (LIN) * Fig. 3; page 7, lines 19-22; page 8, lines 13,14,19-26; page 9, lines 2-11 *	1,5,6	
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A	AT - B - 371 217 (SAINT-GOBAIN) * Page 2, lines 10-12,50-53; page 3, lines 51-54 *	1-5	

TECHNICAL FIELDS SEARCHED (Int Cl.5)

B 32 B 17/00
C 03 C 27/00
C 03 C 17/00
E 06 B 5/00

The present search report has been drawn up for all claims

Place of search	Date of completion of the search	Examiner
VIENNA	28-06-1990	ONDER

CATEGORY OF CITED DOCUMENTS

X : particularly relevant if taken alone
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